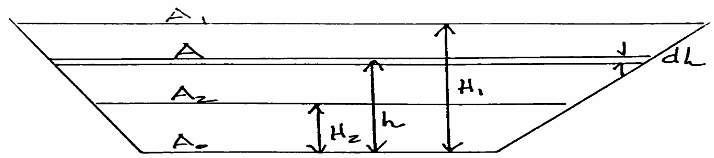
APPENDIX I

Example Calculation Method for Orifice Drawdown Time



WHERE

$$A = A_0 + \left(\frac{A_1 - A_0}{H_1}\right) h$$

$$d\forall = dt \cdot q = C_d a \sqrt{2gh} \cdot dt = -A\,dh$$

WHERE $d\forall$ = CHANGE IN RESERVOIR VOLUME
q = OUTFLOW RATE
C_d = ORIFICE COEFFICIENT OF DISCHARGE
a = ORIFICE AREA
g = ACCELERATION OF GRAVITY
h = HEAD ACTING ON ORIFICE AT TIME (t)

$$dt = \frac{-1}{C_d a \sqrt{2g}} A h^{-1/2}\,dh$$

$$T = \frac{-1}{C_d a \sqrt{2g}} \int_{H_1}^{H_2} A h^{-1/2}\,dh$$

$$= \frac{-1}{C_d a\sqrt{2g}} \int_{H_1}^{H_2} \left[A_o + \left(\frac{A_1 - A_o}{H_1}\right) h\right] h^{-1/2}\, dh$$

$$= \frac{-1}{C_d a\sqrt{2g}} \int_{H_1}^{H_2} \left[A_o h^{-1/2} + \left(\frac{A_1 - A_o}{H_1}\right) h^{1/2}\right] dh$$

$$= \frac{-1}{C_d a\sqrt{2g}} \; 2A_o h^{1/2} + \frac{2}{3}\left(\frac{A_1 - A_o}{H_1}\right) h^{3/2} \Big/_{H_1}^{H_2}$$

$$T = \frac{-1}{C_d a\sqrt{2g}} \left[\left(2A_o H_2^{1/2} + \frac{2}{3}\left(\frac{A_1 - A_o}{H_1}\right) H_2^{3/2}\right) - \left(2A_o H_1^{1/2} + \frac{2}{3}\left(\frac{A_1 - A_o}{H_1}\right) H_1^{3/2}\right)\right]$$

EQUATION 1

$$T = \frac{1}{C_d a\sqrt{2g}} \left[\left(2A_o H_1^{1/2} + \frac{2}{3}\left(\frac{A_1 - A_o}{H_1}\right) H_1^{3/2}\right) - \left(2A_o H_2^{1/2} + \frac{2}{3}\left(\frac{A_1 - A_o}{H_1}\right) H_2^{3/2}\right)\right]$$

FOR THE SPECIFIC CASE WHERE $A_2 = A_0$ AND $H_2 = 0$

$$T = \frac{1}{C_d a \sqrt{2g}} \left[2 A_0 H_1^{1/2} + 2/3 \left(\frac{A_1 - A_0}{H_1} \right) H_1^{3/2} \right]$$

EQUATION 2

$$= \frac{2}{C_d a \sqrt{2g}} \left[\left(2/3\, A_0 + 1/3\, A_1 \right) H_1^{1/2} \right]$$

FOR THE CASE WHERE THE AREA OF THE POND IS NEARLY CONSTANT WITH RESPECT TO DEPTH, EQUATION 1 REDUCES TO EQUATION 3 BELOW.

EQUATION 3

$$T = \frac{2A}{C_d a \sqrt{2g}} \left(\sqrt{H_1} - \sqrt{H_2} \right)$$

WHERE

T = TIME FOR WATER LEVEL TO FALL FROM H_1 TO H_2
A = RESERVOIR AREA
C_d = ORIFICE COEFFICIENT OF DISCHARGE
a = ORIFICE AREA
g = ACCELERATION OF GRAVITY
H_1 = MAXIMUM HEAD ($t = 0$)
H_2 = HEAD WHEN $t = T$ ($H_2 = 0$)

* DOWNSTREAM CONDITIONS SHOULD BE EXAMINED TO DETERMINE THE EFFECTIVE HEAD WHERE THE ORIFICE IS SUBMERGED (THAT IS, CASES WHERE THE TAIL WATER IS HIGHER THAN THE ORIFICE ELEVATION.